CLAIMS

What is claimed is:

1. A method of altering memory capacity in a computer system during operation, the computer system comprising a plurality of removable memory cartridges, the method comprising the acts of:

(a) powering-down one of the plurality of removable memory cartridges, while leaving the remaining memory cartridges operating;

(b) inserting a semiconductor memory device in the one of the plurality of removable memory cartridges;

(c) powering-up the one of the plurality of removable memory cartridges; and

(d) repeating acts (a), (b), and (c) until a semiconductor memory device has been inserted into all of the plurality of memory cartridges.

2. The method, as set forth in claim 1, wherein act (a) comprises the act of operating the remaining memory cartridges in a non-redundant mode.

3. The method, as set forth in claim 1, wherein the plurality of removable memory cartridges store data and parity information in a striped fashion.

4. The method, as set forth in claim 1, wherein act (a) comprises the act of unlocking the one of the plurality of memory cartridges.

5. The method, as set forth in claim 1, comprising the act of initializing each of the semiconductor memory devices.

6. The method, as set forth in claim 1, comprising the act of rebuilding data in each of the semiconductor memory devices.

7. The method, as set forth in claim 1, wherein each of the semiconductor memory devices comprises a dual inline memory module.

8. The method, as set forth in claim 1, wherein the semiconductor memory device is added to the memory cartridge.

9. The method, as set forth in claim 1, wherein the semiconductor memory device replaces a memory device in the memory cartridge.

10. The method, as set forth in claim 1, comprising the acts of:

configuring the semiconductor memory device;

flushing transactions from each of the plurality of memory cartridges; and

resynchronizing each of the plurality of memory cartridges into lockstep operation.

11. A method of increasing the memory capacity in a computer system comprising a plurality of memory cartridges comprising the acts of:

(a) powering-down a first of the plurality of memory cartridges;

(b) inserting a first memory module in an empty module connector, the module connector configured to electrically couple the first memory module to the first of the plurality of memory cartridges;

(c) powering-up the first of the plurality of memory cartridges;

(d) powering-down a second of the plurality of memory cartridges;

(e) inserting a second memory module in an empty module connector, the module connector configured to electrically couple the second memory module to the second of the plurality of memory cartridges;

(f) powering-up the second of the plurality of memory cartridges;

(g) powering-down a third of the plurality of memory cartridges;

(h) inserting a third memory module in an empty module connector, the module connector configured to electrically couple the third memory module to the third of the plurality of memory cartridges;

(i) powering-up the third of the plurality of memory cartridges;

(j) powering-down a fourth of the plurality of memory cartridges;

(k) inserting a fourth memory module in an empty module connector, the module connector configured to electrically couple the fourth memory module to the fourth of the plurality of memory cartridges;

(l) powering-up the fourth of the plurality of memory cartridges;

(m) powering-down a fifth of the plurality of memory cartridges;

(n) inserting a fifth memory module in an empty module connector, the module connector configured to electrically couple the fifth memory module to the fifth of the plurality of memory cartridges;

(o) powering-up the fifth of the plurality of memory cartridges;

(p) initializing each of the memory modules; and

(q) notifying the computer system that the memory modules are available for data storage.

12. The method of increasing the memory capacity in a computer system, as set forth in claim 11, wherein each of the memory modules comprises a Dual Inline Memory Module (DIMM).

13. The method of increasing the memory capacity in a computer system, as set forth in claim 11, wherein the plurality of memory cartridges comprises five memory cartridges.

14. The method of increasing the memory capacity in a computer system, as set forth in claim 11, wherein the plurality of memory cartridges is configured to comprise a redundant memory system.

15. The method of increasing the memory capacity in a computer system, as set forth in claim 14, wherein one of the plurality of memory cartridges is used for parity storage.

16. The method of increasing the memory capacity in a computer system, as set forth in claim 11, wherein the acts of powering-down comprise the act of transitioning the computer system from a first mode of operation to a second mode of operation.

17. The method of increasing the memory capacity in a computer system, as set forth in claim 16, wherein the first mode of operation comprises a redundant mode of operation.

18. The method of increasing the memory capacity in a computer system, as set forth in claim 16, wherein the second mode of operation comprises a non-redundant mode of operation.

19. The method of increasing the memory capacity in a computer system, as set forth in claim 11, wherein the acts of powering-down comprise the act of unlocking a mechanical device, the mechanical device configured to secure the memory cartridge in the computer system.

20. The method of increasing the memory capacity in a computer system, as set forth in claim 19, wherein the mechanical device comprises an electrical switch comprising a locked state and an unlocked state.

21. The method of increasing the memory capacity in a computer system, as set forth in claim 20, wherein the electrical switch is coupled to an audible alarm.

22. The method of increasing the memory capacity in a computer system, as set forth in claim 21, wherein the audible alarm is configured to produce an audible signal in response to an illegal transition of the electrical switch from a locked state to an unlocked state.

23. The method of increasing the memory capacity in a computer system, as set forth in claim 11, wherein the acts of powering-down comprise the acts of:

(a) generating an interrupt to the computer system;

(b) verifying that the computer system is in a redundant mode of operation;

(c) executing a power-down sequence from a data-controller;

(d) resetting each data signal to zero;

(e) driving the zero on each data signal to the memory cartridge;

(f) disabling a clock to the memory cartridge; and

(g) generating an interrupt to the computer system indicating that the power-down-sequence is complete.

24. The method of increasing the memory capacity in a computer system, as set forth in claim 11, wherein the acts of powering-up comprise the acts of:

(a) sequentially connecting a plurality of pins at an interface, the interface comprising a connector configured to couple the memory cartridge to the computer system in response to the memory cartridge being inserted into the computer system;

(b) sequentially enabling a plurality of signals in response to the sequential connection of the plurality of pins;

(c) initializing the memory cartridge;

(d) rebuilding the segment of the memory cartridge; and

(e) verifying the memory cartridge for validity.

25. The method of increasing the memory capacity in a computer system, as set forth in claim 24, wherein the plurality of pins comprise varying pin lengths, the pin lengths assigned to sequentially connect the plurality of pins upon insertion of memory cartridge into the computer system.

26. The method of increasing the memory capacity in a computer system, as set forth in claim 24, wherein act (a) comprises:

(a) connecting one or more ground pins from memory cartridge to the computer system;

(b) connecting one or more power pins from the memory cartridge to the computer system;

(c) connecting one or more first Insertion Removal Sense pins from memory cartridge to the computer system;

(d) connecting one or more data pins from memory cartridge to the computer system; and

(e) connecting one or more second Insertion Removal Sense pins from memory cartridge to the computer system.

27. The method of increasing the memory capacity in a computer system, as set forth in claim 26, wherein the act of connecting the one or more first insertion removal sense pins causes the assertion of a power signal to a power controller.

28. The method of increasing the memory capacity in a computer system, as set forth in claim 27, wherein the assertion of the power signal to the power controller activates power transistors to provide power to the memory cartridge.

29. The method of increasing the memory capacity in a computer system, as set forth in claim 28, wherein the power controller monitors the voltage level at an output of the power transistors and connects a system clock to the memory cartridge when the voltage level reaches a minimum threshold.

30. The method of increasing the memory capacity in a computer system, as set forth in claim 29, wherein the minimum threshold is approximately 2.8 volts.

31. The method of increasing the memory capacity in a computer system, as set forth in claim 26, wherein the act of connecting the one or more second insertion removal sense pins

generates an interrupt from a host controller indicating that the memory cartridge has been installed.

32. The method of increasing the memory capacity in a computer system, as set forth in claim 24, wherein act (b) comprises executing a power-up sequence from a data controller.

33. The method of increasing the memory capacity in a computer system, as set forth in claim 24, comprising locking the memory cartridge into the memory system.

34. A method of increasing the memory capacity in a computer system comprising a plurality of memory cartridges comprising the acts of:

(a) powering-down a first of the plurality of memory cartridges;

(b) removing a first memory module from the first of the plurality of memory cartridges;

(c) inserting a replacement memory module into the first of the plurality of memory cartridges, the replacement memory module having a higher memory capacity than the first memory module;

(d) powering-up the first of the plurality of memory cartridges;

(e) powering-down a second of the plurality of memory cartridges;

(f) removing a second memory module from the second of the plurality of memory cartridges;

(g) inserting a replacement memory module into the second of the plurality of memory cartridges, the replacement memory module having a higher memory capacity than the second memory module;

(h) powering-up the second of the plurality of memory cartridges;

(i) powering-down a third of the plurality of memory cartridges;

(j) removing a third memory module from the third of the plurality of memory cartridges;

(k) inserting a replacement memory module into the third of the plurality of memory cartridges, the replacement memory module having a higher memory capacity than the third memory module;

(l) powering-up the third of the plurality of memory cartridges;

(m) powering-down a fourth of the plurality of memory cartridges;

(n) removing a fourth memory module from the fourth of the plurality of memory cartridges;

(o) inserting a replacement memory module into the fourth of the plurality of memory cartridges, the replacement memory module having a higher memory capacity than the fourth memory module;

(p) powering-up the fourth of the plurality of memory cartridges;

(q) powering-down a fifth of the plurality of memory cartridges;

(r) removing a fifth memory module from the fifth of the plurality of memory cartridges;

(s) inserting a replacement memory module into the fifth of the plurality of memory cartridges, the replacement memory module having a higher memory capacity than the fifth memory module;

(t) powering-up the fifth of the plurality of memory cartridges;

(u) initializing each of the memory modules; and

(v) notifying the computer system that the memory modules are available for data storage.

35. The method of increasing the memory capacity in a computer system, as set forth in claim 34, wherein each of the memory modules comprises a Dual Inline Memory Module (DIMM).

36. The method of increasing the memory capacity in a computer system, as set forth in claim 34, wherein the plurality of memory cartridges comprises five memory cartridges.

37. The method of increasing the memory capacity in a computer system, as set forth in claim 34, wherein the plurality of memory cartridges is configured to comprise a redundant memory system.

38. The method of increasing the memory capacity in a computer system, as set forth in claim 37, wherein one of the plurality of memory cartridges is used for parity storage.

39. The method of increasing the memory capacity in a computer system, as set forth in claim 34, wherein the acts of powering-down comprise the act of transitioning the computer system from a first mode of operation to a second mode of operation.

40. The method of increasing the memory capacity in a computer system, as set forth in claim 39, wherein the first mode of operation comprises a redundant mode of operation.

41. The method of increasing the memory capacity in a computer system, as set forth in claim 39, wherein the second mode of operation comprises a non-redundant mode of operation.

42. The method of increasing the memory capacity in a computer system, as set forth in claim 34, wherein the acts of powering-down comprise the act of unlocking a mechanical device, the mechanical device configured to secure the memory cartridge in the computer system.

43. The method of increasing the memory capacity in a computer system, as set forth in claim 42, wherein the mechanical device comprises an electrical switch comprising a locked state and an unlocked state.

44. The method of increasing the memory capacity in a computer system, as set forth in claim 43, wherein the electrical switch is coupled to an audible alarm.

45. The method of increasing the memory capacity in a computer system, as set forth in claim 44, wherein the audible alarm is configured to produce an audible signal in response to an illegal transition of the electrical switch from a locked state to an unlocked state.

46. The method of increasing the memory capacity in a computer system, as set forth in claim 34, wherein the acts of powering-down comprise the acts of:

(a) generating an interrupt to the computer system;

(b) verifying that the computer system is in a redundant mode of operation;

(c) executing a power-down sequence from a data-controller;

(d) resetting each data signal to zero;

(e) driving the zero on each data signal to the memory cartridge;

(f) disabling a clock to the memory cartridge; and

(g) generating an interrupt to the computer system indicating that the power-down-sequence is complete.

47. The method of increasing the memory capacity in a computer system, as set forth in claim 34, wherein the acts of powering-up comprise the acts of:

(a) sequentially connecting a plurality of pins at an interface, the interface comprising a connector configured to couple the memory cartridge to the computer system in response to the memory cartridge being inserted into the computer system;

(b) sequentially enabling a plurality of signals in response to the sequential connection of the plurality of pins;

(c) initializing the memory cartridge;

(d) rebuilding the segment of the memory cartridge; and

(e) verifying the memory cartridge for validity.

48. The method of increasing the memory capacity in a computer system, as set forth in claim 47, wherein the plurality of pins comprise varying pin lengths, the pin lengths assigned to sequentially connect the plurality of pins upon insertion of memory cartridge into the computer system.

49. The method of increasing the memory capacity in a computer system, as set forth in claim 47, wherein act (a) comprises:

(a) connecting one or more ground pins from memory cartridge to the computer system;

(b) connecting one or more power pins from the memory cartridge to the computer system;

(c) connecting one or more first Insertion Removal Sense pins from memory cartridge to the computer system;

(d) connecting one or more data pins from memory cartridge to the computer system; and

(e) connecting one or more second Insertion Removal Sense pins from memory cartridge to the computer system.

50. The method of increasing the memory capacity in a computer system, as set forth in claim 49, wherein the act of connecting the one or more first insertion removal sense pins causes the assertion of a power signal to a power controller.

51. The method of increasing the memory capacity in a computer system, as set forth in claim 50, wherein the assertion of the power signal to the power controller activates power transistors to provide power to the memory cartridge.

52. The method of increasing the memory capacity in a computer system, as set forth in claim 51, wherein the power controller monitors the voltage level at an output of the power transistors and connects a system clock to the memory cartridge when the voltage level reaches a minimum threshold.

53. The method of increasing the memory capacity in a computer system, as set forth in claim 52, wherein the minimum threshold is approximately 2.8 volts.

54. The method of increasing the memory capacity in a computer system, as set forth in claim 49, wherein the act of connecting the one or more second insertion removal sense pins

generates an interrupt from a host controller indicating that the memory cartridge has been installed.

55. The method of increasing the memory capacity in a computer system, as set forth in claim 47, wherein act (b) comprises executing a power-up sequence from a data controller.

56. The method of increasing the memory capacity in a computer system, as set forth in claim 47, comprising locking the memory cartridge into the memory system.